George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

QD-QA-025
REVISION I
EFFECTIVE DATE: APRIL 12, 2006

ORGANIZATIONAL ISSUANCE

EDDY CURRENT INSPECTION

OPR(s)	**OPR DESIGNEE**
QD10, QD20, QD30, and QD40	**Rickey Clements**

DOCUMENT HISTORY LOG

Status (Baseline/ Revision/ Canceled)	Document Revision	Effective Date	Description
Baseline		10/17/97	
Revision	A	01/29/99	Section 4.2.2 Added guidance concerning requirement for Certificate of Conformance (COC).
Revision	B	05/15/99	Add MSFC-STD-1249 and ASTM E-46 to paragraph 5.1 Reference Documents.
Revision	C	7/1/99	Changes made to reflect new organization code changes and/or Changes made to reflect new directives renumbering scheme and to incorporate the corrective action for closure of NCR 266
Revision	D	8/10/00	MPG 8730.1, "Inspection and Test" was added to the Applicable Documents section. Other changes made were to the Reference Documents section of the OI. The following documents were added: ASTM E-426, "Recommended Practice for Electromagnetic (Eddy Current) Testing of Seamless and Welded Tubular Products, Austenitic", and MSFC-STD-1249, "Standard NDE Guidelines and Requirements for Fracture Control Programs".
Revision	E	9/09/02	Format and numbering change to implement requirements of QS-A-001 rev F.
Revision	F	10/08/02	Administrative changes only. Changes made to reflect new organization. Revised document reference in Applicable Documents.
Revision	G	10/1/04	Revised to bring document in compliance with the HQ Rules Review Action (CAITS: 04-DA01-0387). Changes were also made to reflect S&MA organizational name changes (i.e., QS to QD).
Revision	H	11/22/2005	Administrative Revision changed OPR
Revision	I	4/12/2006	Administrative Revision changed OPR

EDDY CURRENT INSPECTION

1. PURPOSE, SCOPE, APPLICABILITY

1.1. Purpose – This instruction provides requirements for the performance of eddy current inspection to comply with MPR 8730.1.

1.2. Scope – This instruction provides detailed requirements for performing eddy current inspection.

1.3. Applicability – This instruction is applicable to all MSFC Safety and Mission Assurance (S&MA) personnel, MSFC NDE Team personnel and support contractor personnel who perform eddy current inspection.

2. DOCUMENTS (Applicable and/or Reference)

2.1. Applicable Documents

MWI 3410.1	Personnel Certification Program
MPR 8730.1	Inspection and Testing

2.2. Reference Documents

ASTM E-426	Recommended Practice for Electromagnetic (Eddy Current) Testing of Seamless and Welded Tubular Products, Austenitic
MSFC-STD-1249	Standard NDE Guidelines and Requirements for Fracture Control Programs

3. DEFINITIONS

None

4. INSTRUCTIONS

4.1. General

4.1.1. The equipment shall be capable of energizing the test coils or probes with alternating currents of frequencies in the range of at least 5 MHz to 50 HZ and shall be capable of sensing the changes in the electromagnetic response of the sensors.

4.1.2. Test coils shall be capable of inducing current in the material and sensing changes in the electrical characteristics of the material.

4.1.3. Probe coils shall be capable of inducing current in the material and sensing changes in the electrical characteristics of the material. Probes will consist of an exciting coil and sensing coil or Hall element mounted in a common or special holder. NOTE: Lift-off effect is an important consideration since coupling variations can effect the test significantly.

4.1.4. Eddy current inspection shall be in accordance with the requirements of this procedure and applicable work authorizing documentation. The probe coil technique shall be utilized. The reference standard shall have a simulated open surface crack (EDM notch) of 0.080 + 0.005 inches in length, 0.010 +/- 0.001 inches in depth, and width not exceeding 0.007; and a corner crack having radial pattern and radius of 0.030+/- 0.003 inches, and width not exceeding 0.007 inches for standard inspection.

4.1.5. For special level inspection, the reference standard shall have a simulated open surface crack of 0.040+/- 0.004 inches in length, 0.010 +/- 0.001 inches in depth, and width not exceeding 0.007 inches; and a corner crack having a radial pattern and radius of 0.020 +/- 0.002 inches, width not exceeding 0.007 inches.

4.1.6. A signal-to noise response of no less than 3:1 shall be demonstrated on the appropriate reference standard (s) utilized, for both standard and special inspections.

4.1.7. Appropriate probe designs and/or probe adapters shall be utilized to assure reliable, repeatable inspections.

4.1.8. Eddy current testing does not require etch removal of typically smeared material in order to detect surface crack-like flaws, and may be used on coated surfaces.

4.1.9. The surface to be inspected shall be flat, or have consistent, regular geometry, and be readily accessible.

4.1.10. The surface shall be either bare metal or have a consistent thickness of coating or plating not exceeding 0.003 inches thickness.

4.1.11. The material to be inspected must be paramagnetic or non-magnetic.

4.1.12. The material shall have a surface finish of 125 RMS or better.

4.2. Calibration

The calibration process shall be performed as follows, or as specified in approved procedures:

4.2.1. Select the test frequency, coil or probe, design, phase, discrimination, and other circuitry, as well as speed of testing, which shall demonstrate the system capability for detecting the discontinuities of interest.

4.2.2. Select the applicable reference standard. For optimum inspection standardization, the reference standard shall be of the same composition and/or conductivity as the material being inspected. All procured reference standards shall have a Certificate of Conformance (COC).

4.2.3. Adjust the equipment to obtain an optimum signal-to-noise ratio with the minimum 3:1 response of sensitivity required to detect the artificial discontinuities in the reference standard. Move the probe or coil under conditions, such as testing speed, identical to those to be used in inspection of the material, and adjust to desired sensitivity.

4.3. Procedure

The procedure shall be performed as follows, or as specified in approved procedures:

4.3.1. Determine whether the surface roughness and part geometry of the item to be inspected are compatible with the type of inspection to be performed. The surface of the material shall be free of dirt, metal chips, excessive oil, foreign particles, and other contaminants that will interfere with the inspection.

4.3.2. Visually inspect the part for cracks, burrs, nicks, gouges, raised areas, irregular machining, and tool tears. Any surface defects that will impair eddy current testing must be removed or marked for later evaluation.

4.3.3. The inspection of flaws inside a material requires a low frequency to get penetration into the material.

4.3.3.1. Set the frequency range knob that controls the frequency of the probe. Fine tune to desired frequency.

4.3.3.2. Set the gain to approximately 30, initially. This may require adjustment.

4.3.3.3. Place probe on reference standard and press NULL push-button. A spot should be displayed near center of CRT.

4.3.3.4. Use position controls to put the spot at the desired location, and adjust Gain or Sensitivity as required.

4.3.3.5. Press ERASE button, CRT should be clear.

4.3.3.6. Set filter(s) as desired to obtain optimum signal response.

4.3.3.7. Set the VERT and HOR sensitivity to 2 volt/division.

4.3.3.8. Perform lift-off adjustment as follows:

a. Slowly and continuously move probe up and down from reference standard.

b. Move the rotation control until a horizontal line is obtained. The spot should be going from center to left of screen as probe is taken from sample.

4.3.3.9. The CRT line should be nearly horizontal. Use the VERT or HOR position controls to set the line to desired part of screen as probe is taken off the sample.

4.3.3.10. Move the probe over the sample area that has the desired notch. The notch signal should appear on the CRT neat center.

4.3.3.11. Adjust gain and sensitivity as required for desired notch signal size, to the desired level for the defect to be analyzed. After changing gain, null the instrument and reposition the spot. The signal-to-noise response shall be no less that 3:1.

4.4. Flaw Detection

Flaw detection shall be performed as follows, or as required by approved procedures: - Place the probe in position on the unit under test and scan for possible discontinuities. Care must be taken to see that the probe is in the proper position at all times since any jarring between the probe and the unit under test will cause a change in impedance.

4.4.1. Mark the part to indicate the location of any discontinuity.

4.4.2. Re-examine repaired areas using the same equipment and technique as for the original inspection.

4.5. Acceptance Criteria - All discontinuities found shall be cause for rejection unless otherwise noted on the engineering drawings or other design engineering documentation. If no discontinuities are detected, stamp and date the work authorizing document. Complete the record of eddy current inspection (Appendix A) and attach it to the work authorizing documentation. Retain a copy of the inspection record.

5. NOTES

5.1 This issuance replaces QS10-QA-025 Revision F, “Eddy Current Inspection”’ dated 10/08, 2002.

5.2 Records are maintained by the Quality Assurance Records Center for flight hardware and by the using organization for test stand and facility hardware.

6. SAFETY PRECAUTIONS AND WARNING NOTES

None

7. APPENDICES, DATA, REPORTS, AND FORMS

Appendix A Eddy Current Inspection Record

8. RECORDS

None

9. TOOLS, EQUIPMENT, AND MATERIALS

a. Electromagnetic Eddy Current test equipment generating frequencies over a range of 5 MHz to 50 HZ.

b. Coil Probes: absolute, differential, ID, OD, surface, reflection; various frequencies.

c. Coaxial cables.

d. Standard reference blocks for various alloys

e. Probe adapters: standard and custom.

10. PERSONNEL TRAINING AND CERTIFICATION

Personnel training and certification is required in accordance with MWI 3410.1.

11. FLOW DIAGRAM

None

Appendix A

EDDY CURRENT INSPECTION RECORD

TPS/WORK AUTH. # _____ PROG./PROJ._____

INSP DATE _____ INSP. PROC. #/REV _____

ACCEP. SPEC. #/REV _____ SAMPLE NAME _____

SAMPLE ID _____ ACCEPT REJECT

BRIEF PEDIGREE (manufacture, if stressed)_____
_____

REFERENCE TO COMPLETE
PEDIGREE_____

_____

DATA REFERENCES_____

FREQUENCY _____ PROBE SIZE _____

OTHER PROBE CHARACTERISTICS _____

TYPE OF CORE (AIR/FERRITE) WINDING CONFIGURATION

HOW PHASE ANGLE WAS SELECTED _____

TECHNIQUE: 1 0R 2 TRANSDUCER/ TRANSMISSION REFLECTION

MAKE AND MODEL OF EQUIPMENT _____

SCALE OR SCAN (MM/PIXEL, etc.) _____

INSPECTOR _____ LEVEL _____

EMPLOYER _____